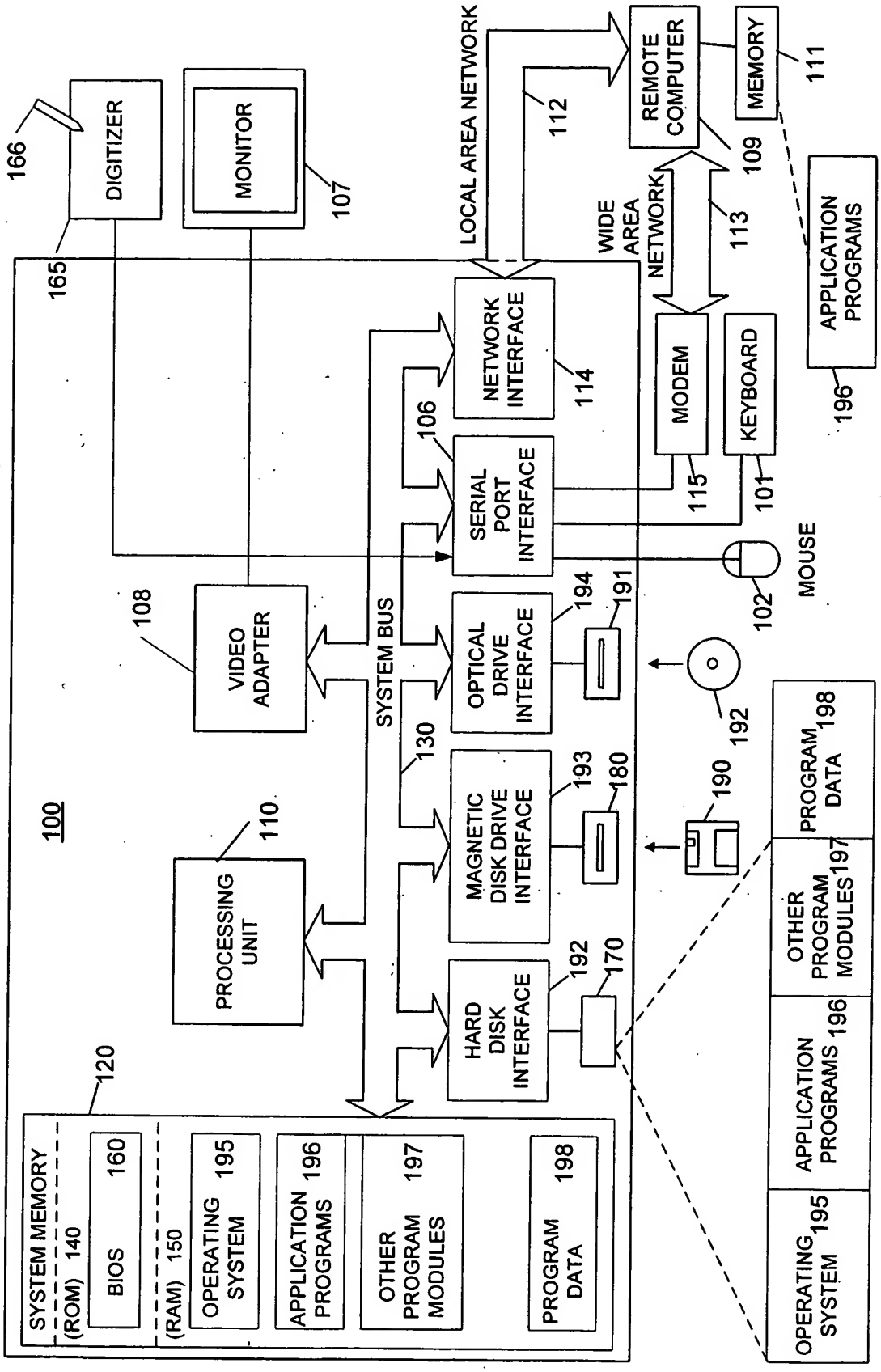

100
SYSTEM MEMORY
(ROM) 140
BIOS 160
(RAM) 150
OPERATING SYSTEM 195
APPLICATION PROGRAMS 196
OTHER PROGRAM MODULES 197
PROGRAM DATA 198
120
PROCESSING UNIT 110
VIDEO ADAPTER 108
HARD DISK INTERFACE 192 170
MAGNETIC DISK DRIVE INTERFACE 193 180
OPTICAL DRIVE INTERFACE 194 191
SERIAL PORT INTERFACE 106
NETWORK INTERFACE 114
SYSTEM BUS 130
DIGITIZER 166 165
MONITOR 107
MOUSE 102
KEYBOARD 101
MODEM 115
LOCAL AREA NETWORK 112
WIDE AREA NETWORK 113
REMOTE COMPUTER 109
MEMORY 111
APPLICATION PROGRAMS 196
PROGRAM DATA 198
OTHER PROGRAM MODULES 197
APPLICATION PROGRAMS 196
OPERATING SYSTEM 195

Figure 1

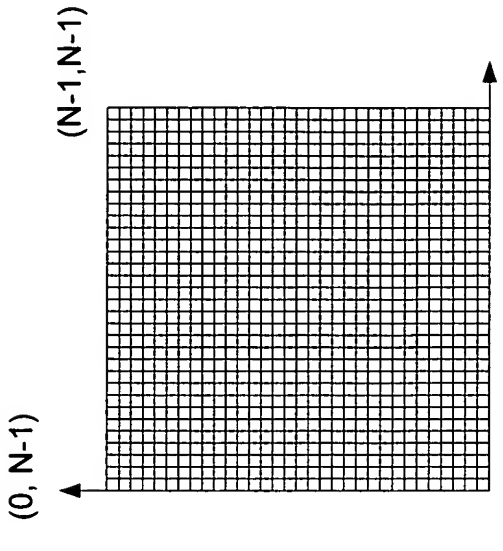


Figure 2B

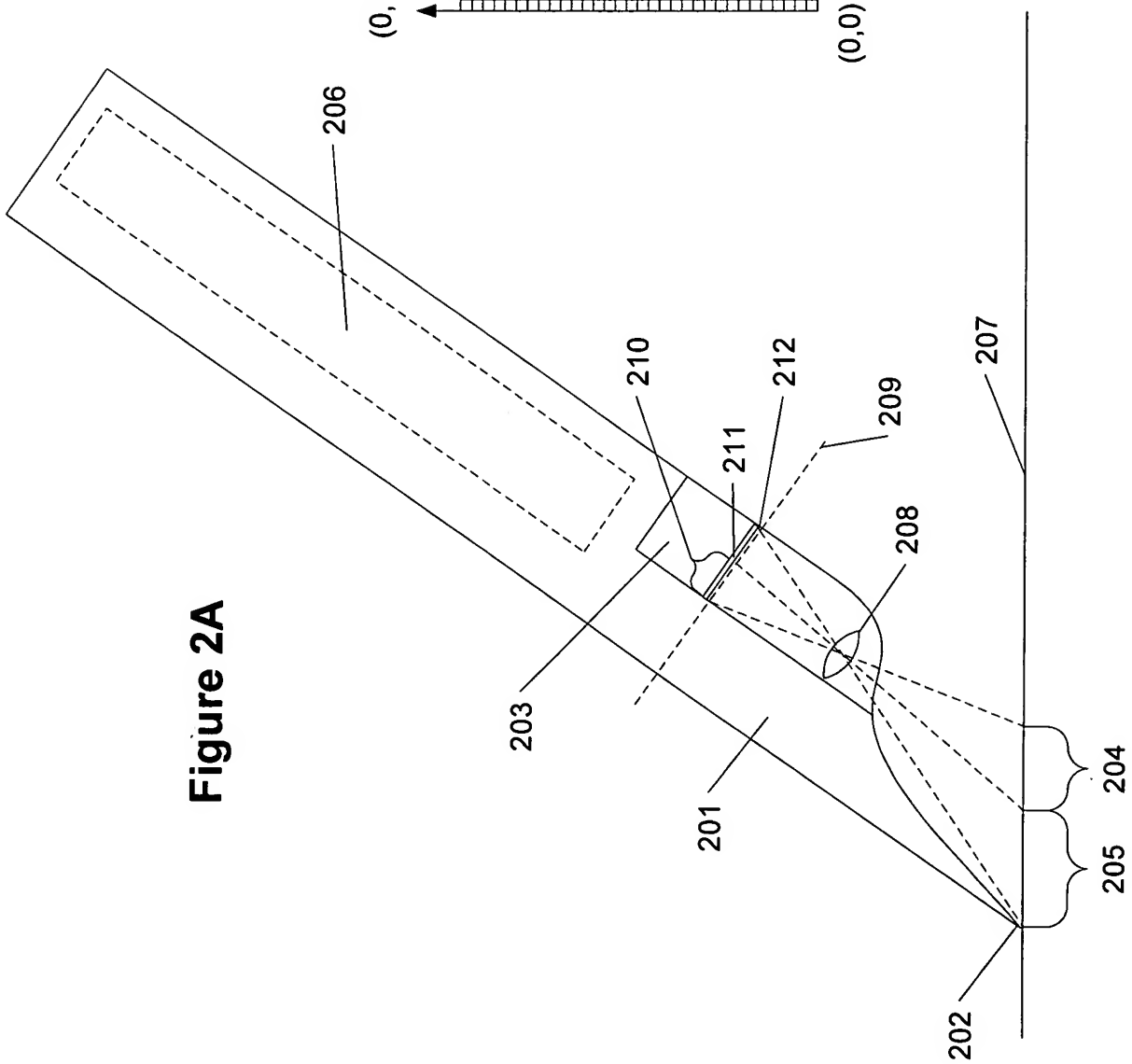


Figure 2A

Figure 3A 0000010 00 01100 0101 001 111010 0 0111001 0 010110 111 0110 01101 01 0111111

Figure 3B 0000000 0011101 0100111 1110100 0111010 1000101 1110100 0100111 0011101

Figure 3C 000100100 001111110 010111101 010011001 011100111 001011010 011000011

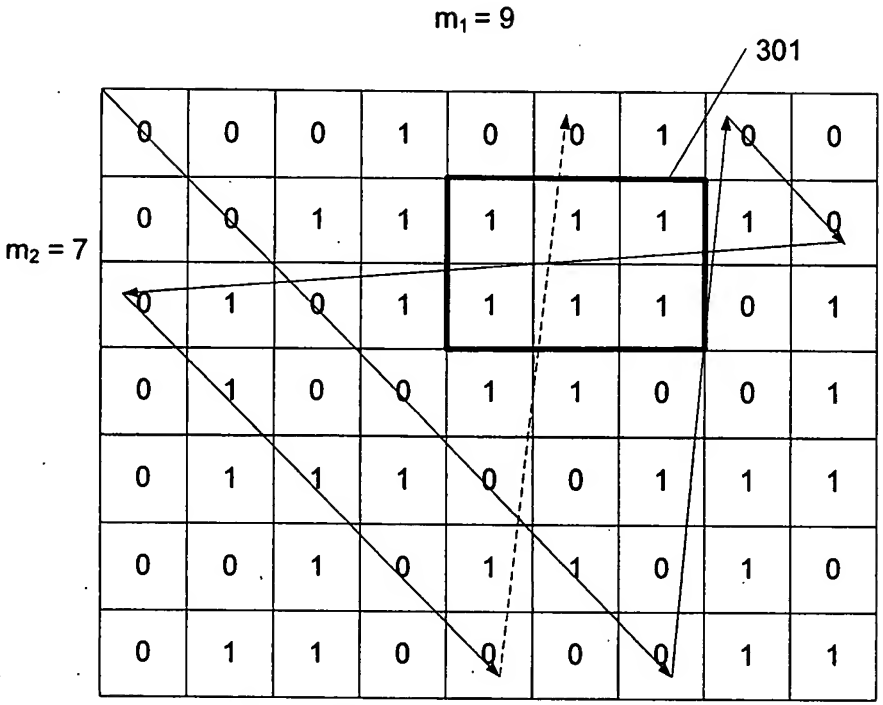


Figure 3D

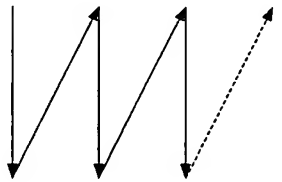


Figure 3E

Figure 3F

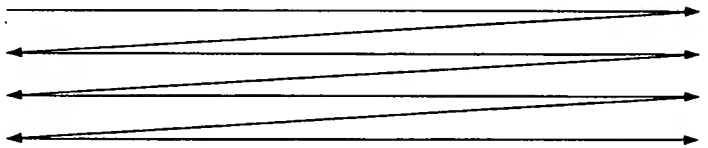


Figure 4A

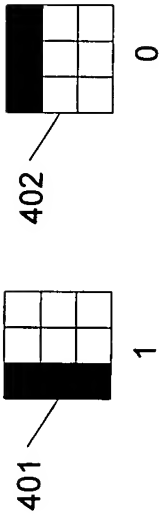


Figure 4B

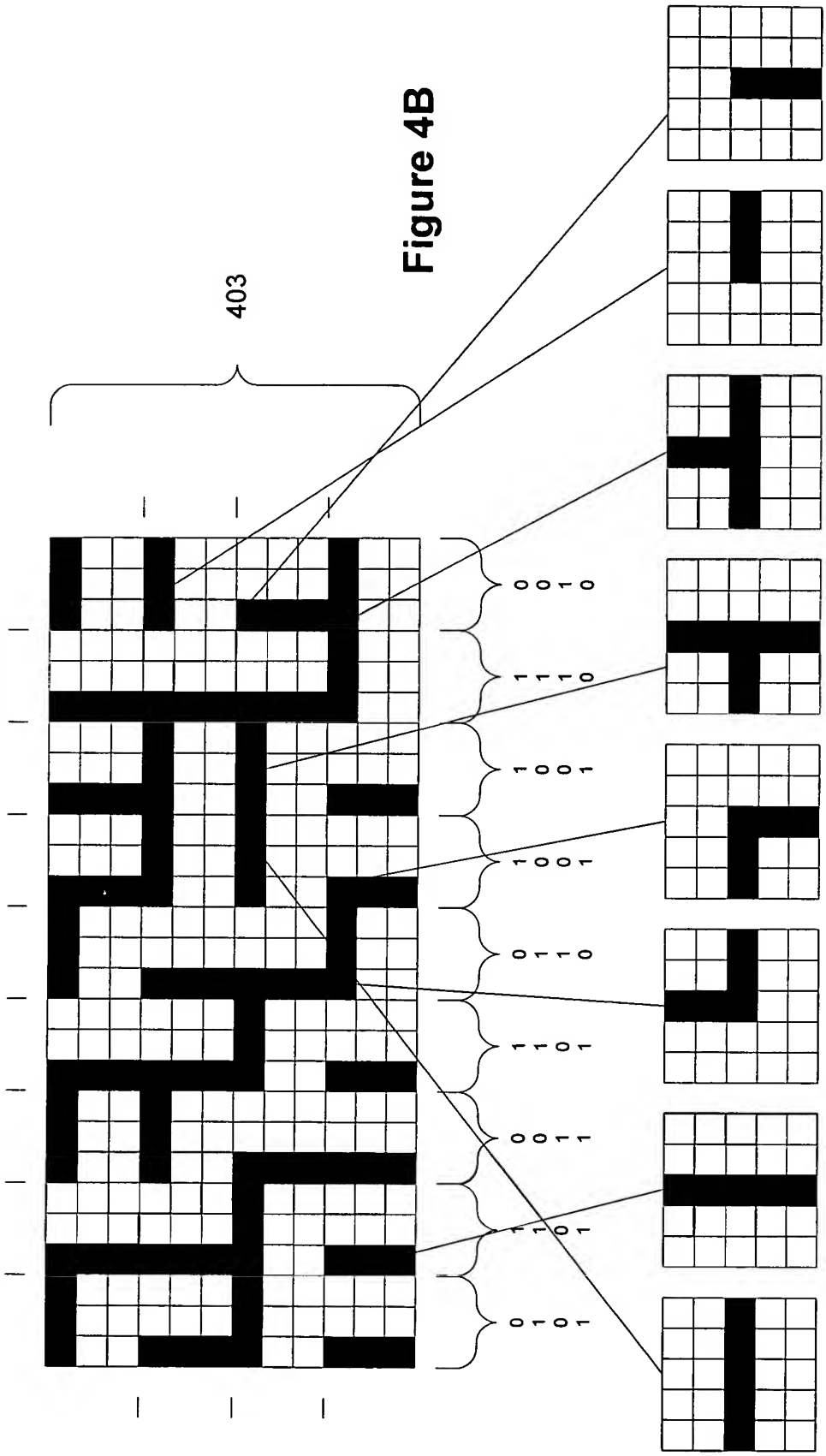


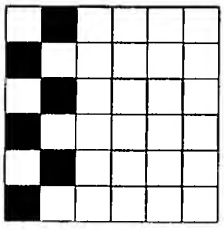
Figure 5A

Figure 5B

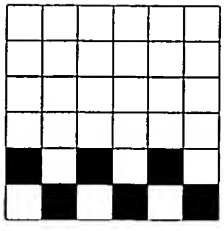
Figure 5C

Figure 5D

Figure 4C

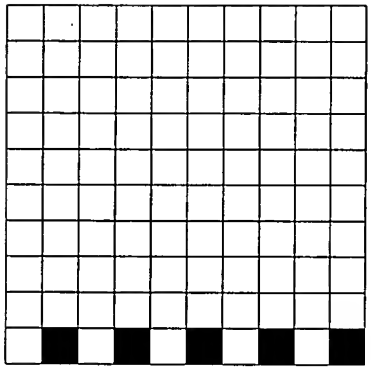


0

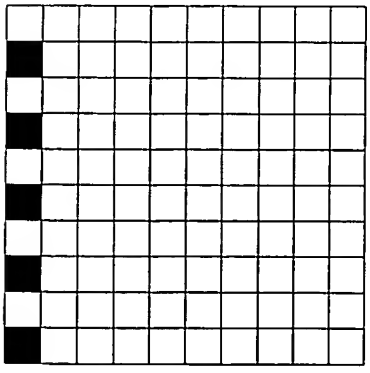


1

Figure 4D

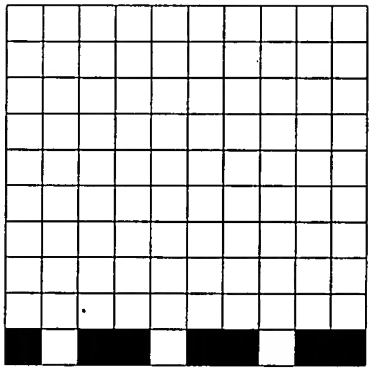


0

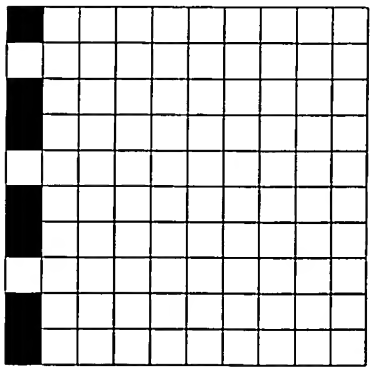


1

Figure 4E



0



1

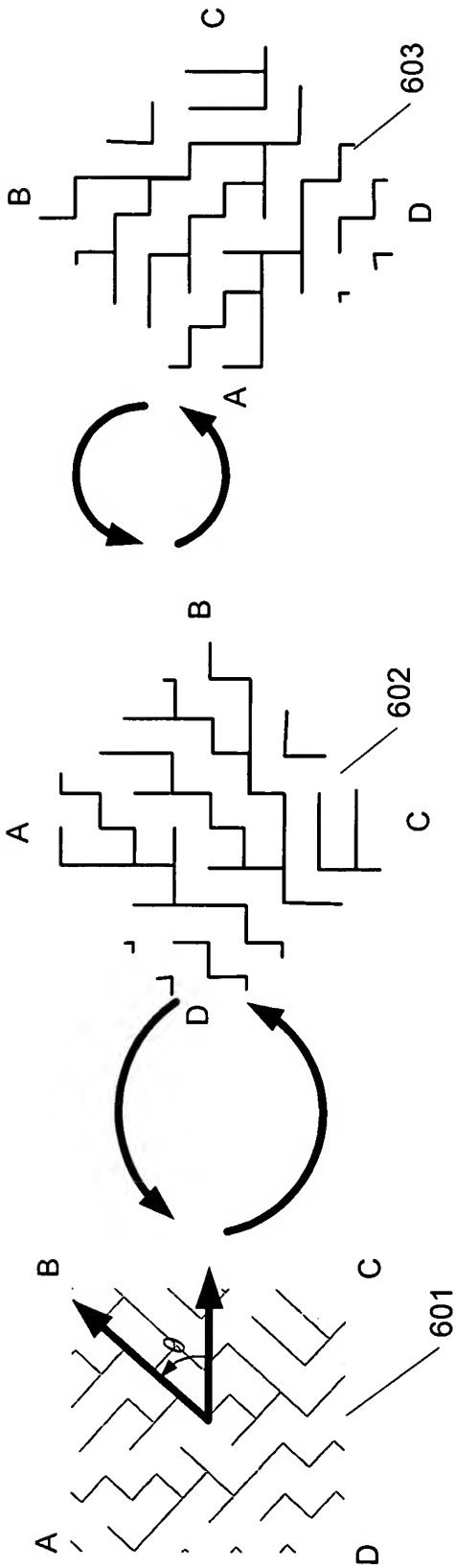


Figure 6

$$o = \theta + \begin{cases} 0 - no\ a \\ \frac{\pi}{2} - no\ b \\ \pi - no\ c \\ \frac{3\pi}{2} - no\ d \end{cases}$$

Figure 7

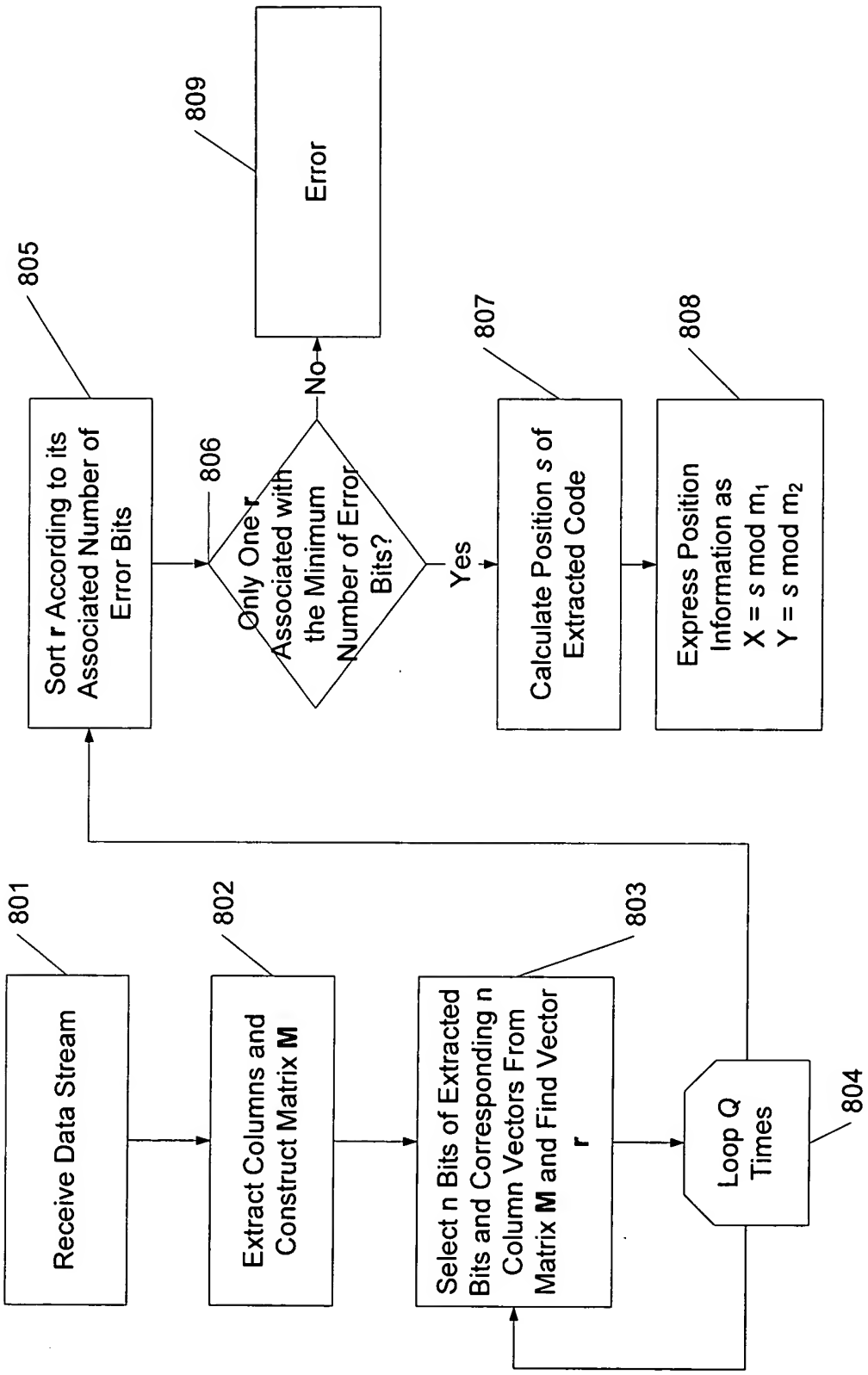

801
Receive Data Stream
802
Extract Columns and Construct Matrix M
803
Select n Bits of Extracted Bits and Corresponding n Column Vectors From Matrix M and Find Vector r
804
Loop Q Times
805
Sort r According to its Associated Number of Error Bits
806
Only One r Associated with the Minimum Number of Error Bits?
No
Yes
807
Calculate Position s of Extracted Code
808
Express Position Information as X = s mod m1 Y = s mod m2
809
Error

Figure 8

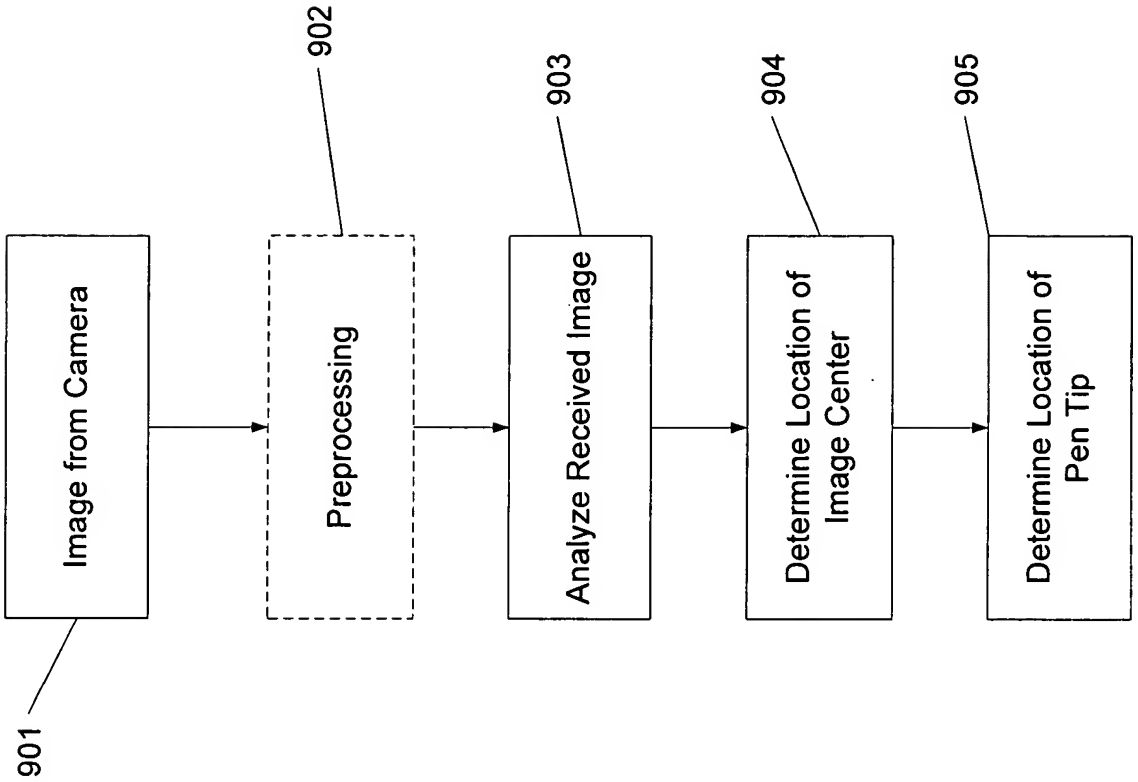
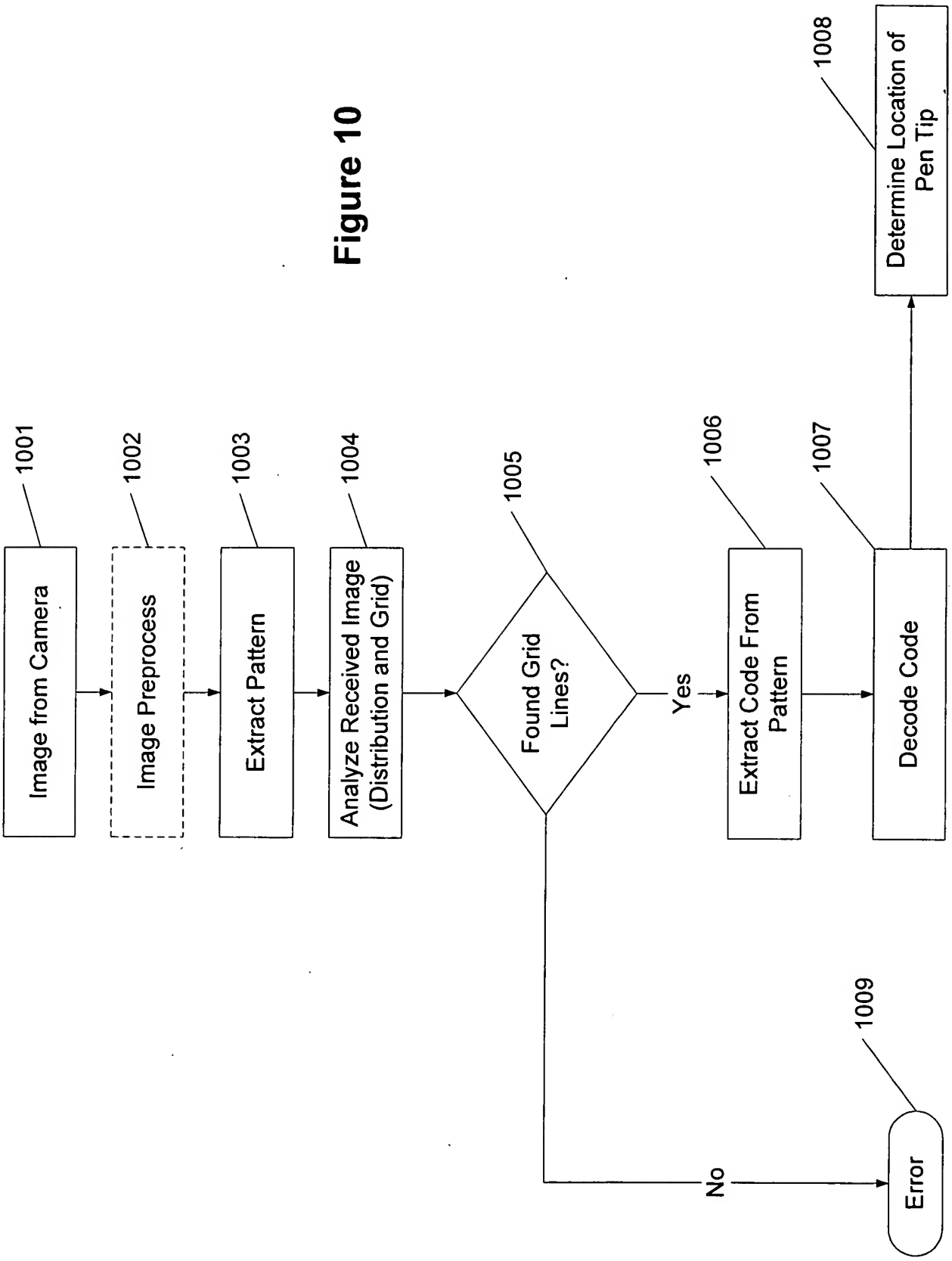

901
Image from Camera
902
Preprocessing
903
Analyze Received Image
904
Determine Location of Image Center
905
Determine Location of Pen Tip

Figure 9

Figure 10


1001
Image from Camera
1002
Image Preprocess
1003
Extract Pattern
1004
Analyze Received Image (Distribution and Grid)
1005
Found Grid Lines?
Yes
1006
Extract Code From Pattern
1007
Decode Code
1008
Determine Location of Pen Tip
No
1009
Error

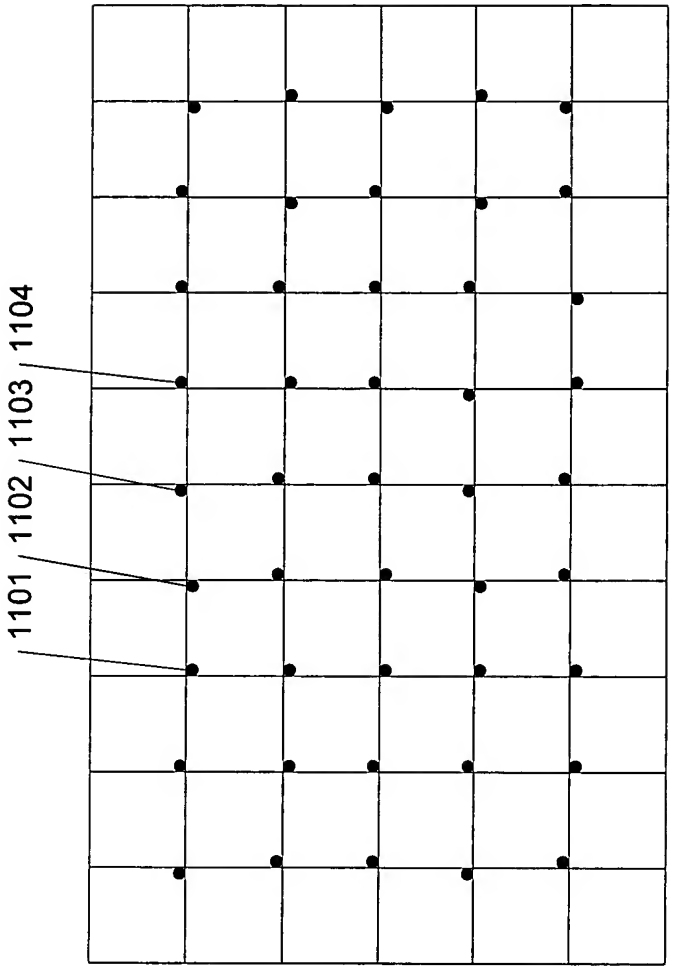


Figure 11 (Prior Art)

1200

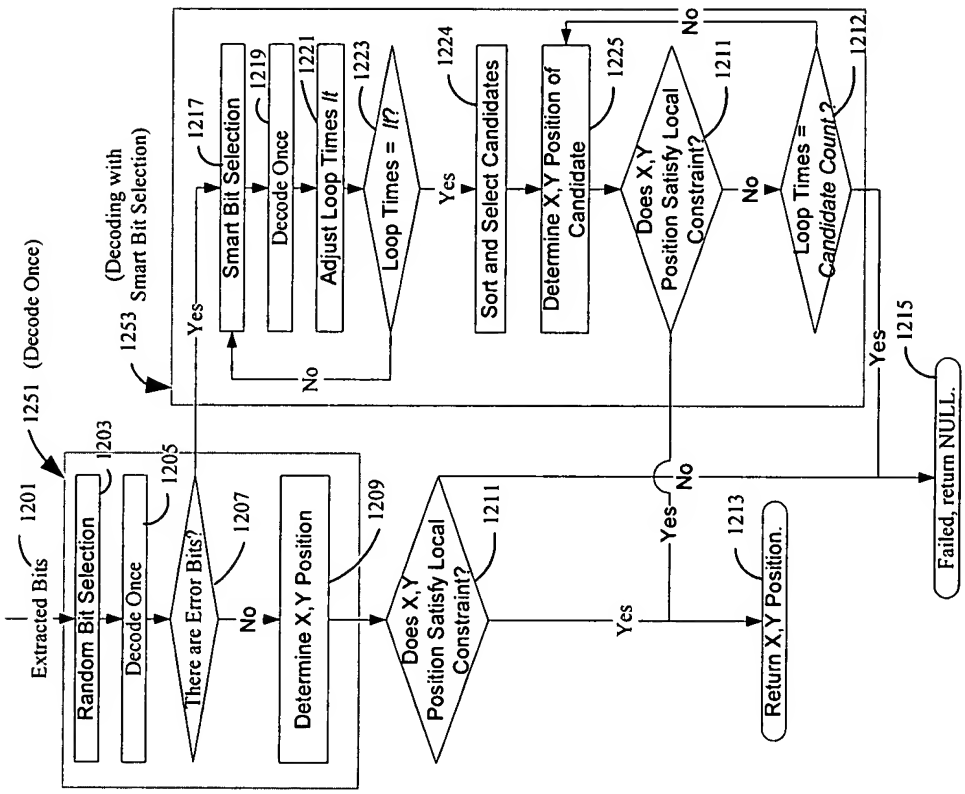

Extracted Bits
1201
1251 (Decode Once)
Random Bit Selection
1203
Decode Once
1205
There are Error Bits?
1207
No
Determine X,Y Position
1209
Does X,Y Position Satisfy Local Constraint?
1211
Yes
No
Return X,Y Position.
1213
Failed, return NULL.
1215
Yes
1253 (Decoding with Smart Bit Selection)
Smart Bit Selection
1217
Decode Once
1219
Adjust Loop Times It
1221
Loop Times = It?
1223
Yes
No
Sort and Select Candidates
1224
Determine X,Y Position of Candidate
1225
Does X,Y Position Satisfy Local Constraint?
1211
No
Yes
Loop Times = Candidate Count?
1212
No
Yes

FIG. 12

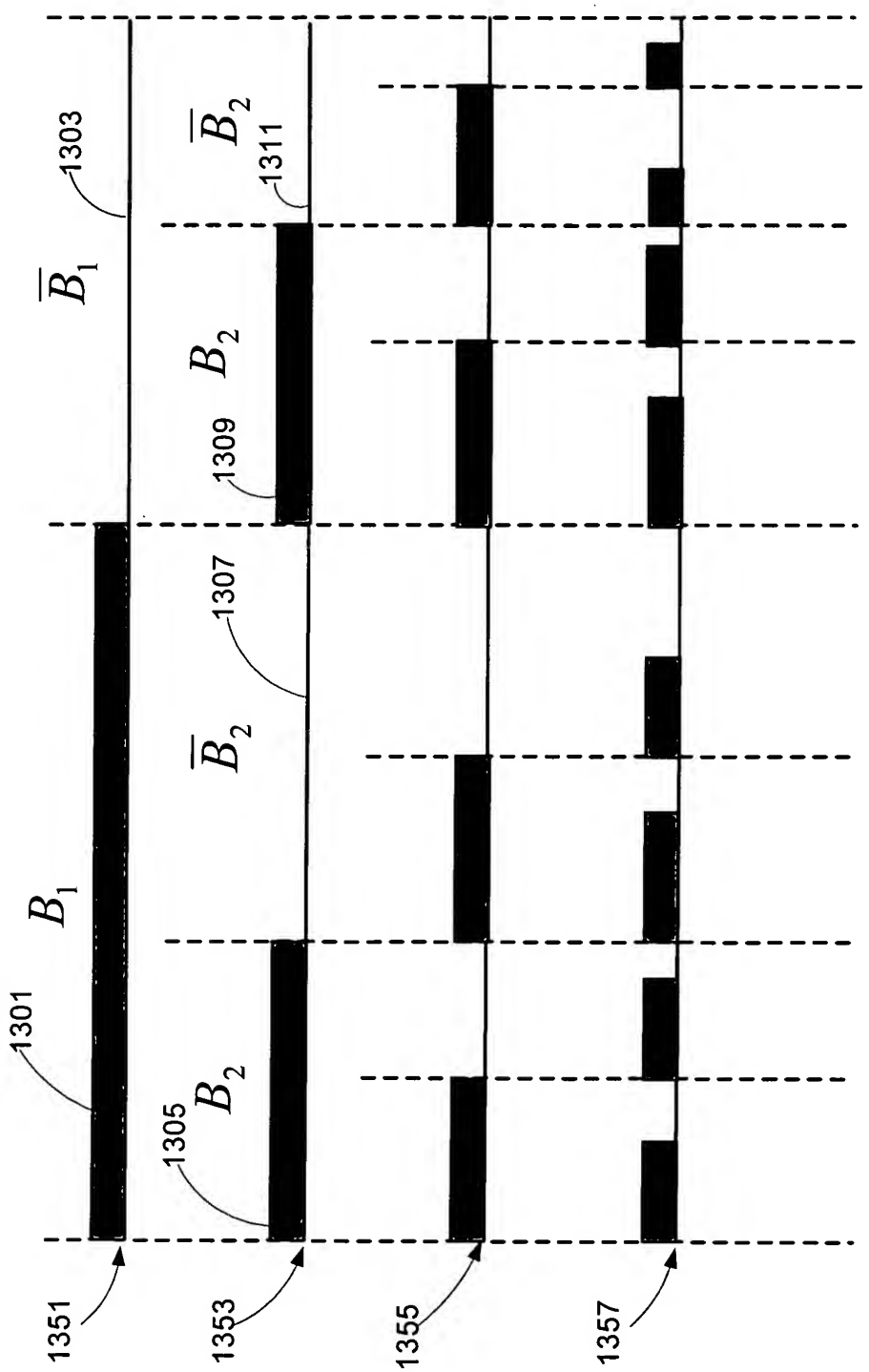

$\overline{B}_1$
B_1
B_2
$\overline{B}_2$
B_2
$\overline{B}_2$
1301
1303
1305
1307
1309
1311
1351
1353
1355
1357

FIG. 13

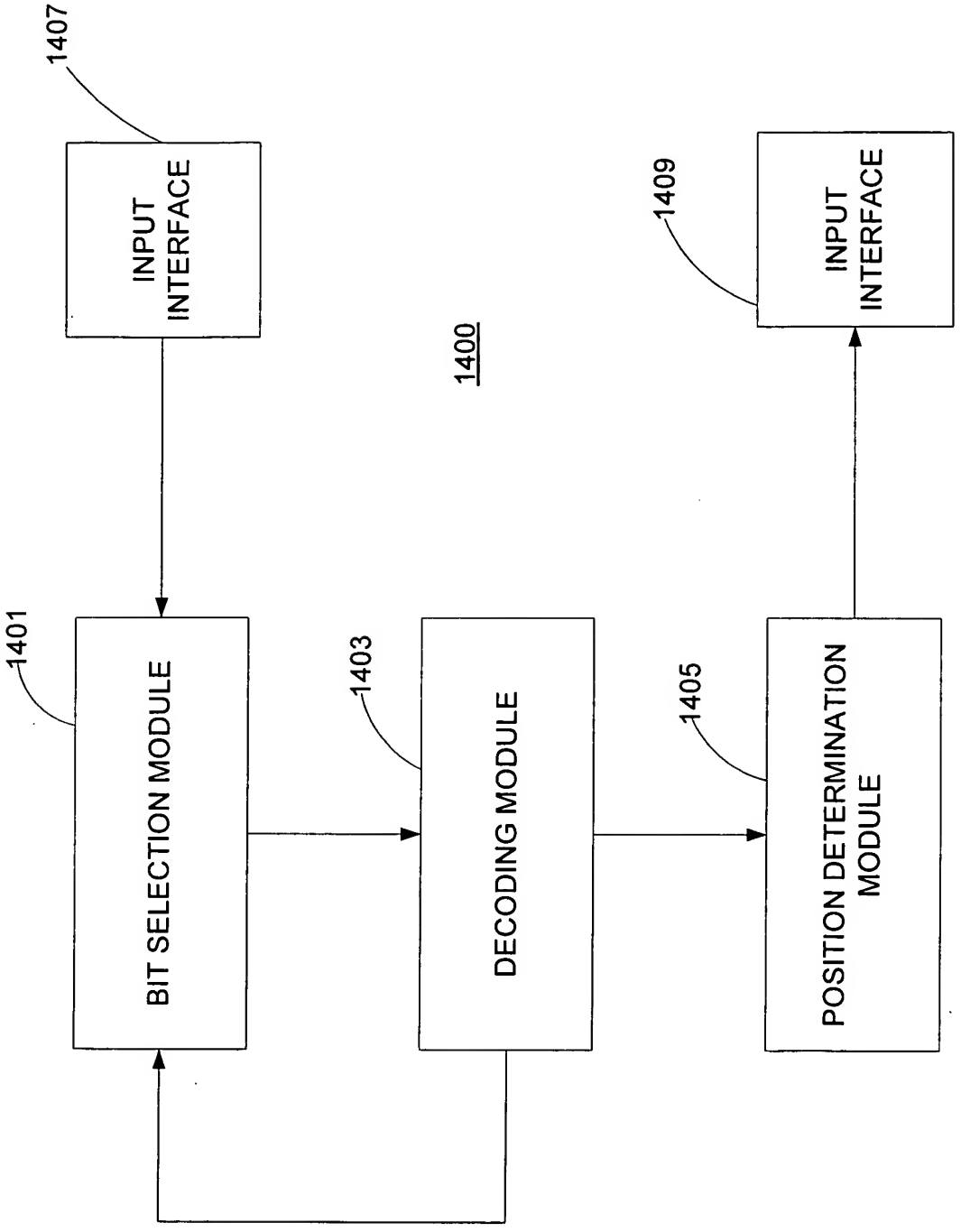

1407
INPUT INTERFACE
1409
INPUT INTERFACE
1400
1401
BIT SELECTION MODULE
1403
DECODING MODULE
1405
POSITION DETERMINATION MODULE

FIG. 14

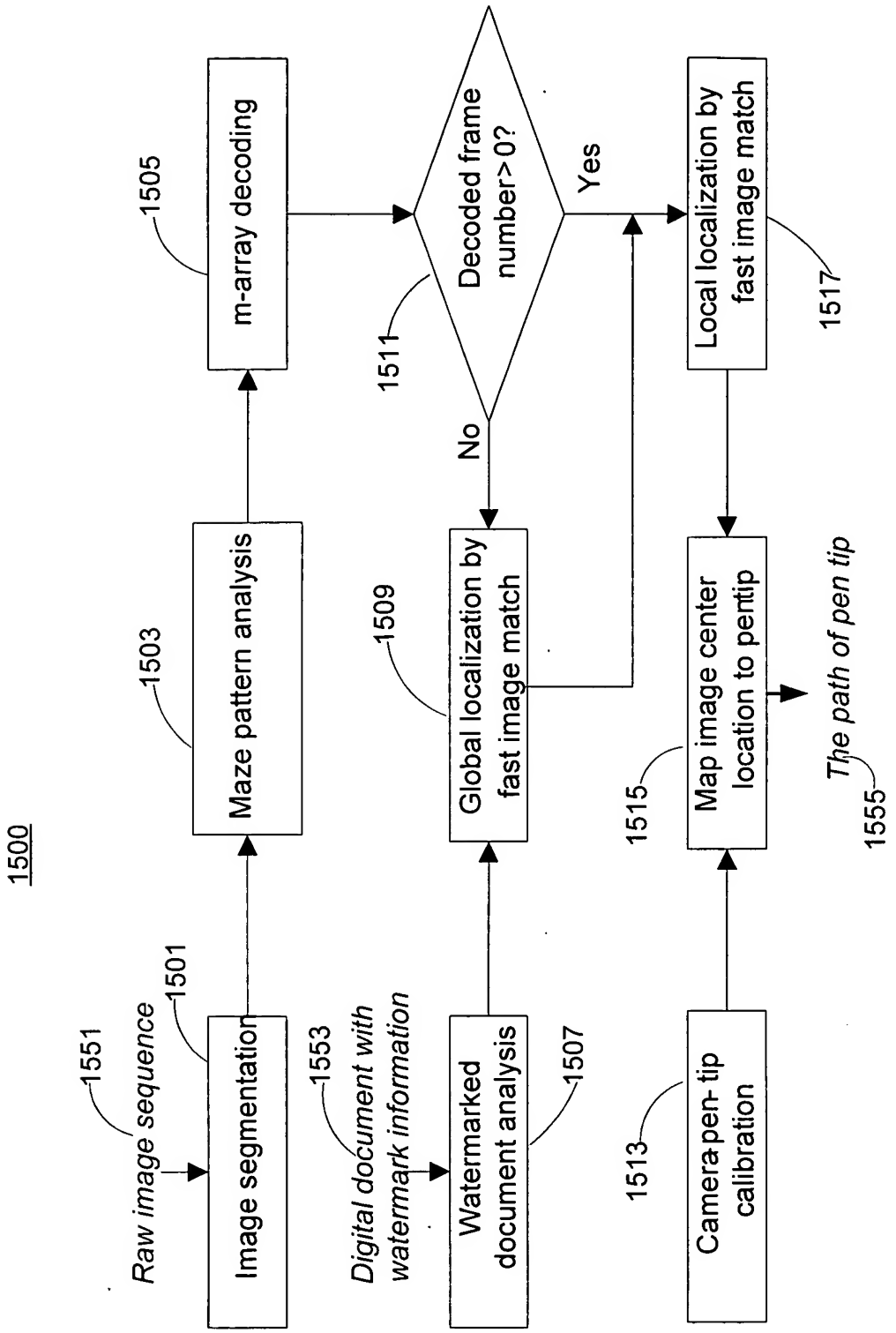

1500
1551
Raw image sequence
1501
Image segmentation
1553
Digital document with watermark information
Watermarked document analysis
1507
1513
Camera-pen-tip calibration
Maze pattern analysis
1503
m-array decoding
1505
Global localization by fast image match
1509
Decoded frame number>0?
1511
Yes
No
Local localization by fast image match
1517
Map image center location to pentip
1515
The path of pen tip
1555

FIG. 15

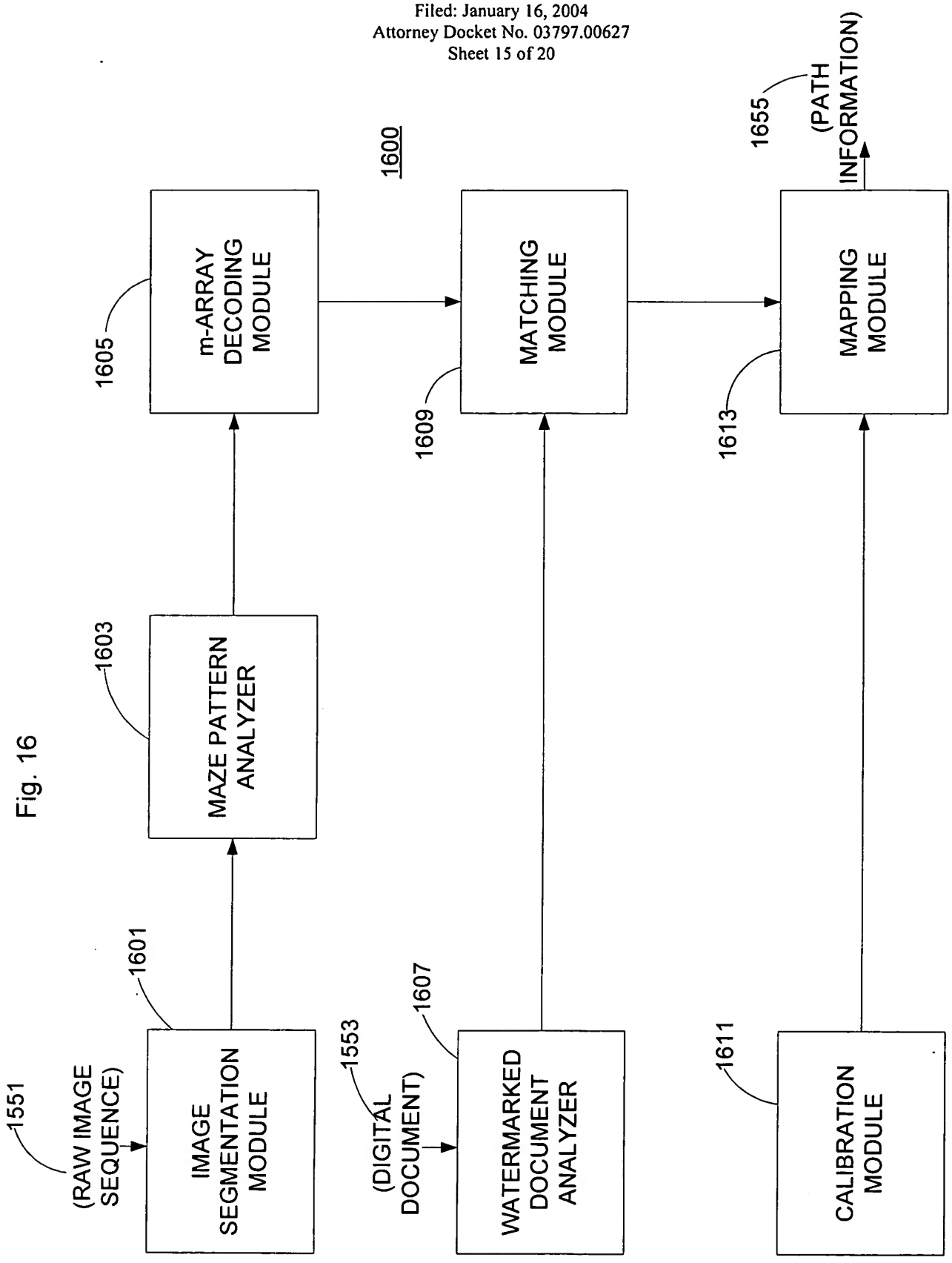

1600
1551
(RAW IMAGE SEQUENCE)
1601
IMAGE SEGMENTATION MODULE
1603
MAZE PATTERN ANALYZER
1605
m-ARRAY DECODING MODULE
1553
(DIGITAL DOCUMENT)
1607
WATERMARKED DOCUMENT ANALYZER
1609
MATCHING MODULE
1611
CALIBRATION MODULE
1613
MAPPING MODULE
1655
(PATH INFORMATION)

Fig. 16

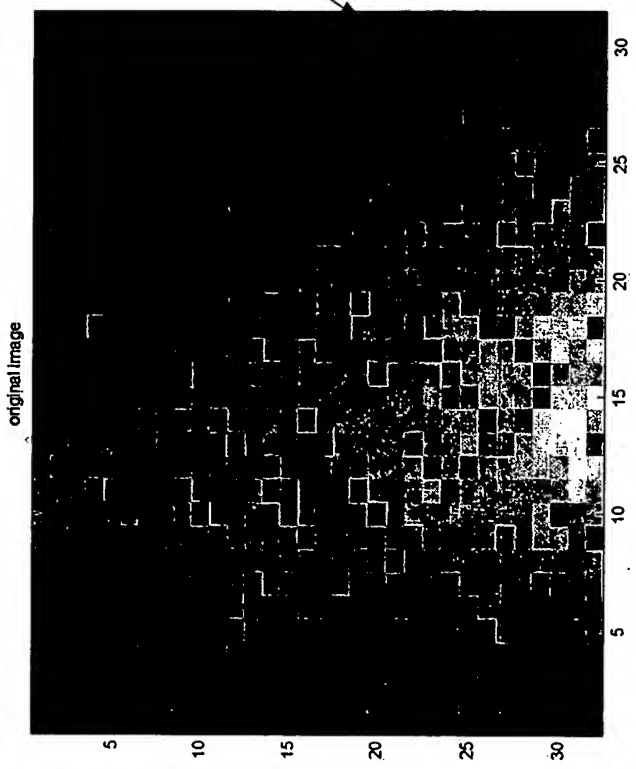

1700
original image
5
10
15
20
25
30

FIG. 17

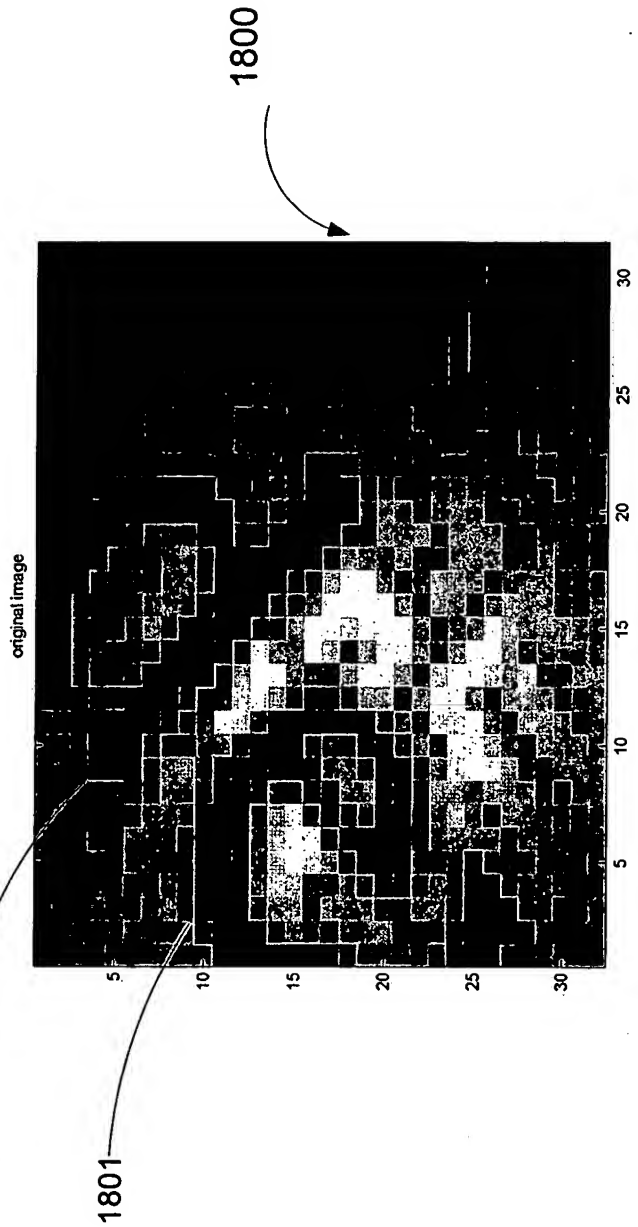

1800
original image
1803
1801
5
10
15
20
25
30

FIG. 18

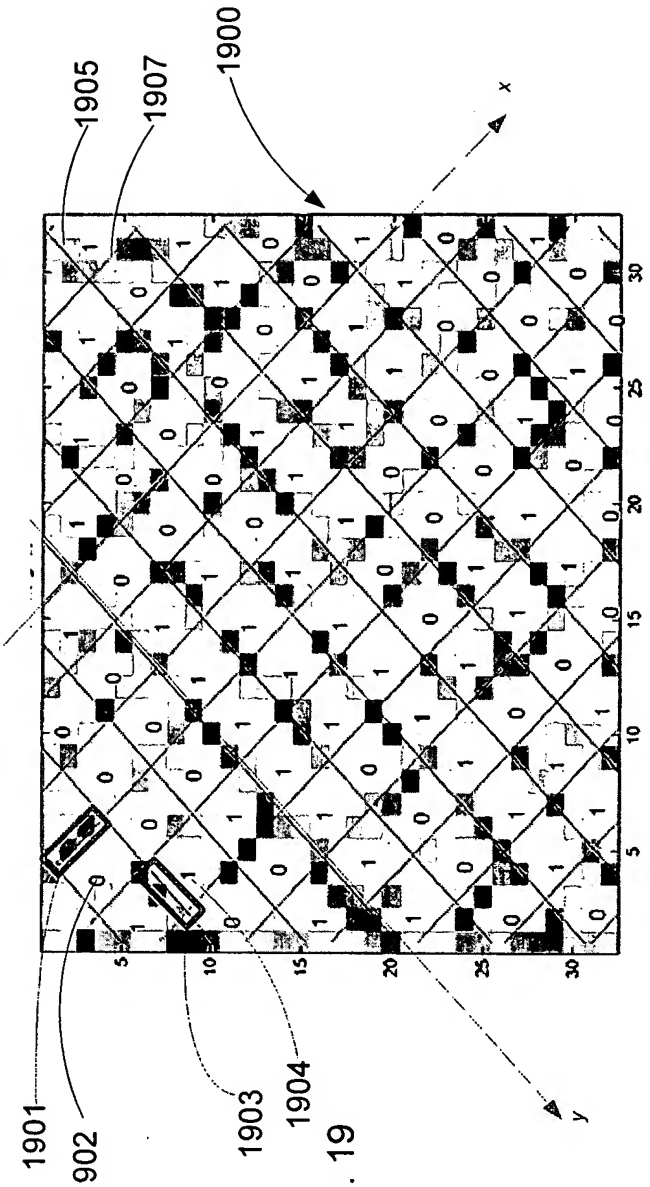


FIG. 19

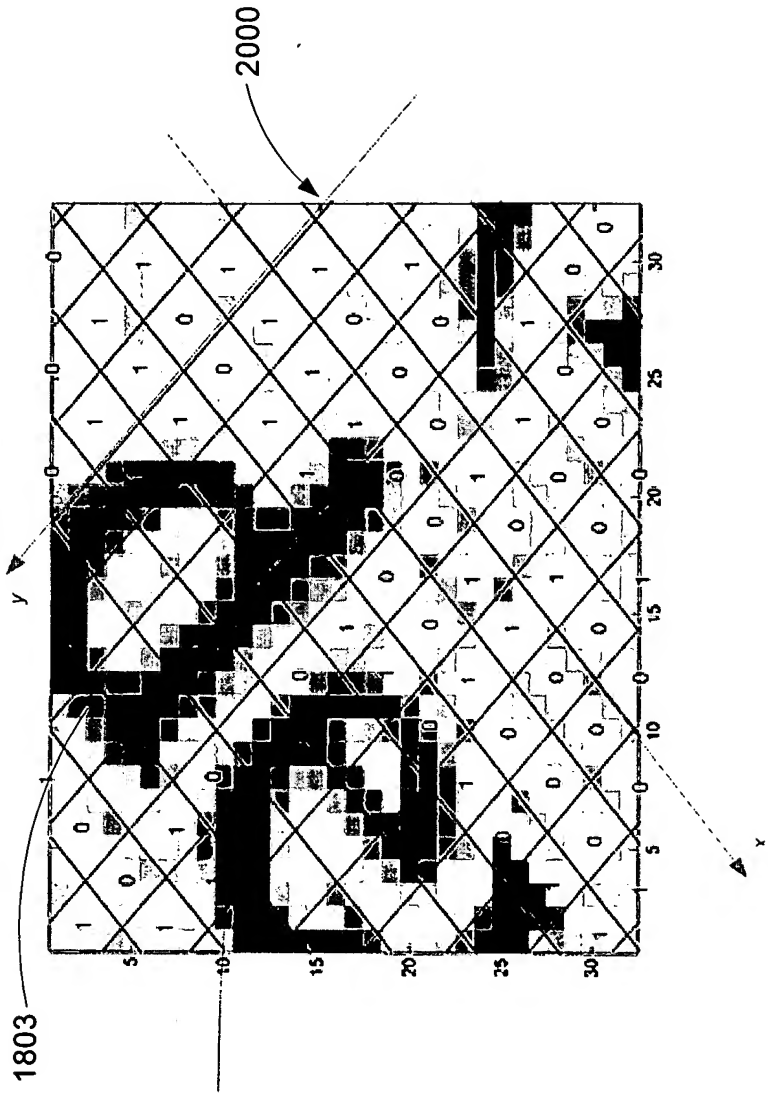


FIG. 20

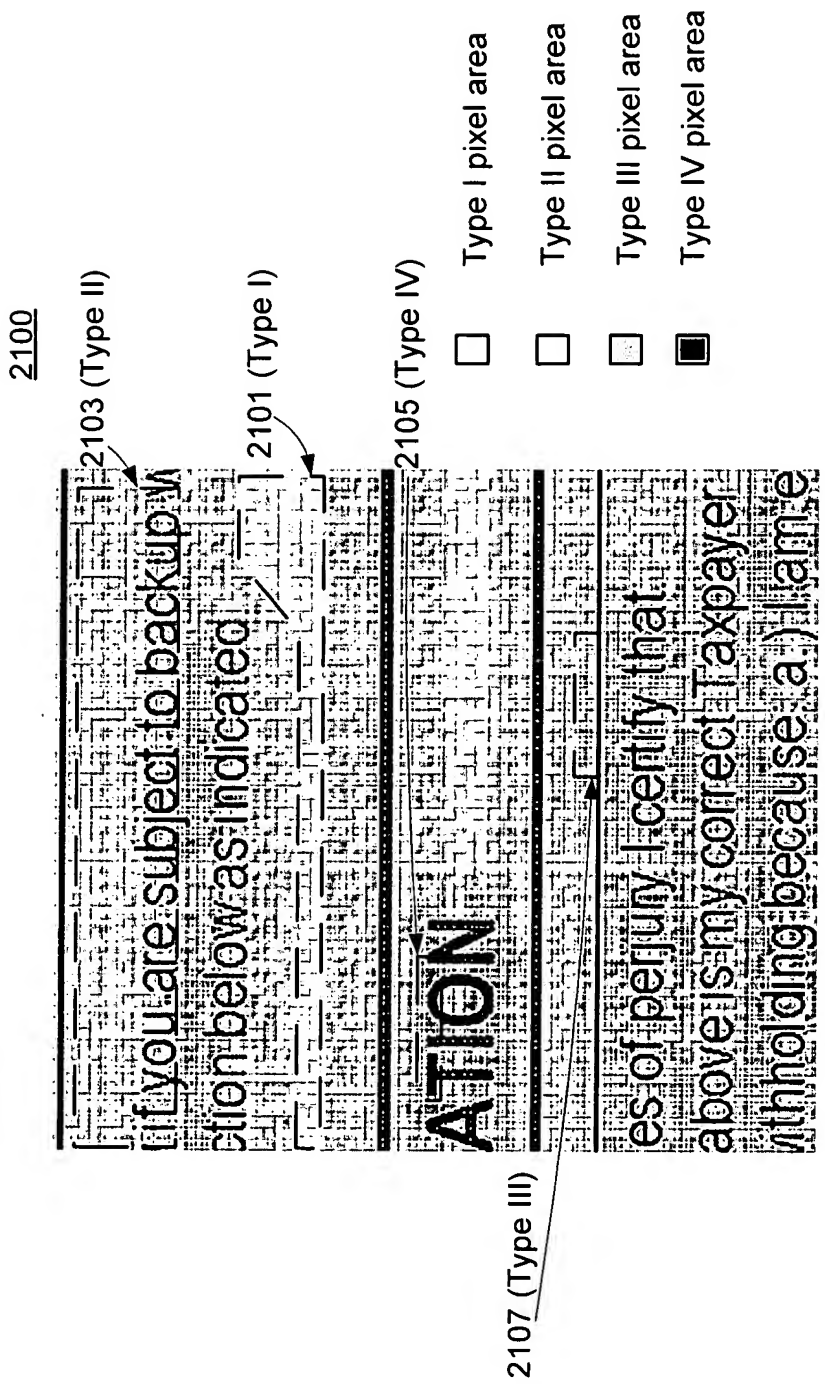

2100
2103 (Type II)
2101 (Type I)
2105 (Type IV)
Type I pixel area
Type II pixel area
Type III pixel area
Type IV pixel area
if you are subject to backup w
tion below as indicated
ATION
es of perjury, I certify that
above is my correct Taxpayer
nholding because a.) I am e
2107 (Type III)

FIG. 21

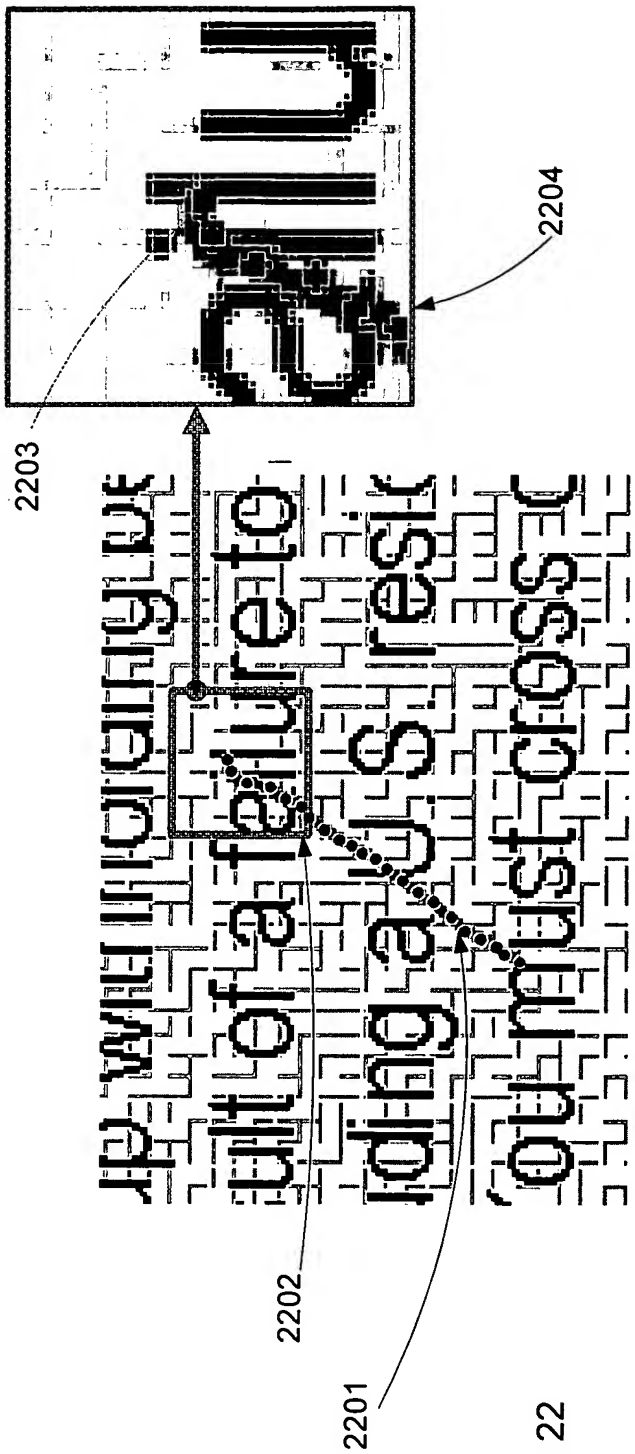


FIG. 22

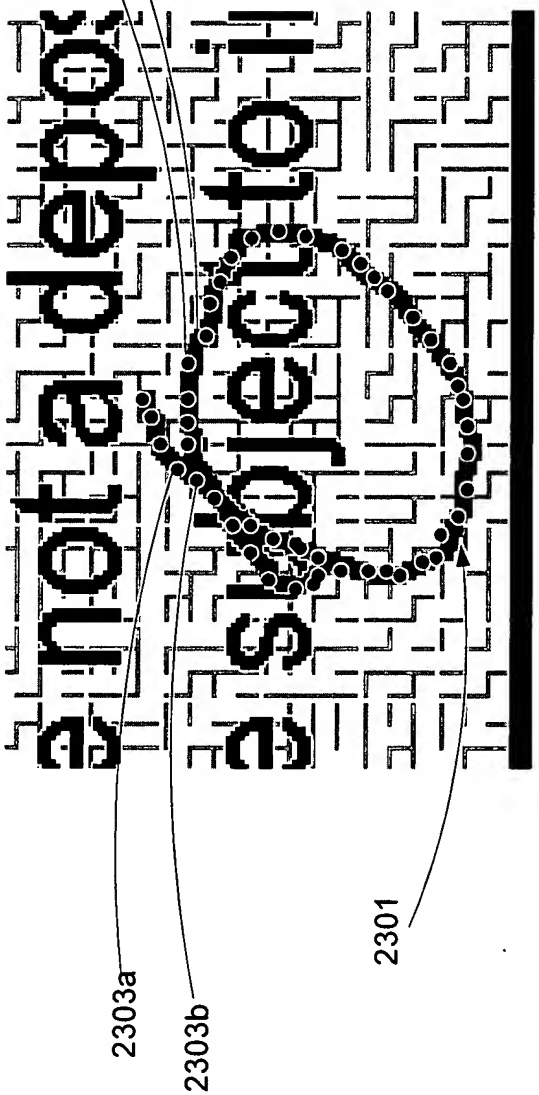


FIG. 23

FIG. 24

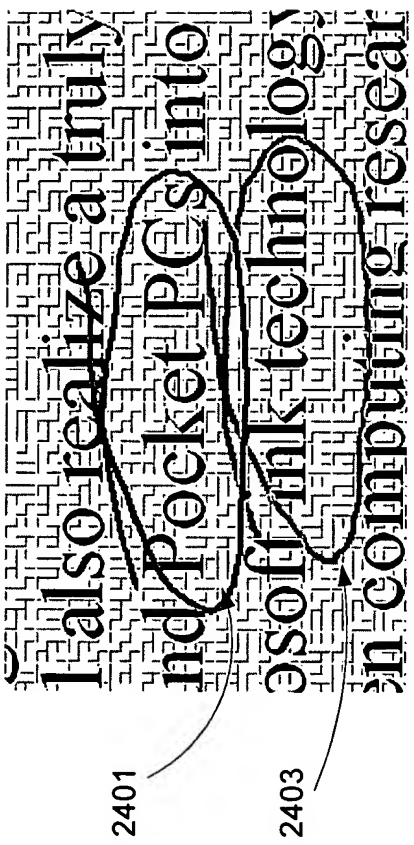
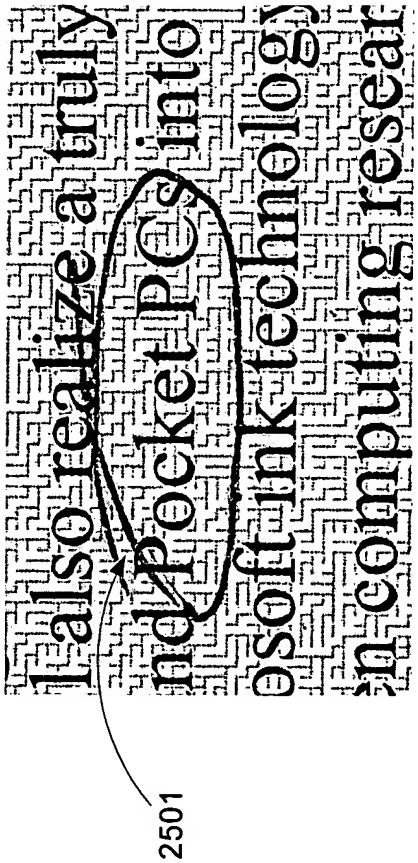

also realize a truly
and Pocket PCs into
a soft ink technology
in computing resear
2401
2403

FIG. 25


also realize a truly
and Pocket PCs into
a soft ink technology
in computing resear
2501